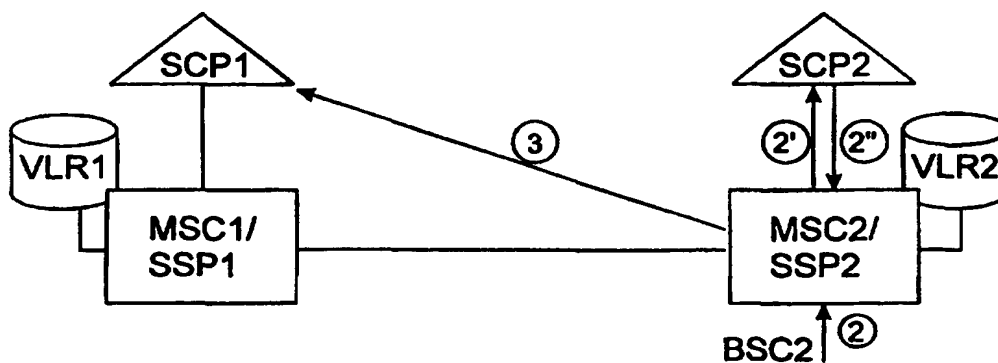




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>H04Q 7/22</b>		A1	(11) International Publication Number: <b>WO 97/48245</b>
			(43) International Publication Date: 18 December 1997 (18.12.97)
(21) International Application Number: PCT/FI97/00346 (22) International Filing Date: 3 June 1997 (03.06.97) (30) Priority Data: 962380 7 June 1996 (07.06.96) FI (71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): JANHONEN, Risto [FI/FI]; Brontie 2 as. 17, FIN-02400 Kirkkonummi (FI). TUOHINO, Markku [FI/FI]; Koivusyrjä 25 F, FIN-02130 Espoo (FI). TURKULAINEN, Veli [FI/FI]; Korsitie 2 H 16, FIN-00730 Helsinki (FI). (74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the</i> <i>claims and to be republished in the event of the receipt of</i> <i>amendments.</i>	

(54) Title: IMPROVING CHARGING CRITERIA FOR A CALL IN A CELLULAR MOBILE NETWORK



## (57) Abstract

If the location cell of a calling subscriber (MS-A) or a called subscriber (MS-B) belongs to a set of special cells (CS) at the beginning of a call, a cheaper tariff is applied. According to the invention, the charging criterion is updated in the beginning and during the call. If a subscriber roams from the area of a public network cell to the set of special cells (CS), the cell information propagates to the MSC of the called subscriber. The MSC and/or service control point SCP compares this cell information with the set of special cells (CS) and determines that the new cell of the called subscriber belongs to the special cells (CS), due to which the tariff can be changed. Information on the called subscriber's changed cell type is transmitted to the mobile switching centre (MSC, stage 3) of the calling subscriber.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

## IMPROVING CHARGING CRITERIA FOR A CALL IN A CELLULAR MOBILE NETWORK

### BACKGROUND OF THE INVENTION

The invention relates to a method of improving charging criteria for  
5 a call in a cellular mobile network according to the preamble of claim 1. The invention further relates to a mobile system implementing such a method.

EP application 0 597 638 discloses a cellular telephone system wherein the charging tariff applicable to each mobile telephone depends on the area in which it is located. Each base station broadcasts an identifying signal on its control channel. Each mobile telephone responds by displaying to  
10 the user in identification of the cell or corresponding area.

The solution disclosed in said '638 application suffers from several disadvantages. One major disadvantage is that it requires modifications to each of the mobile telephones. Another disadvantage is a possibility for misuse of the system. Such a situation may arise e.g. when the subscriber starts  
15 a call from a special cell entitled to a more advantageous tariff and moves away from that cell during the call. Alternatively, the subscriber may move during the call from a public cell to a special cell, in which case he would be entitled to a cheaper tariff. This does not happen, however, because the call  
20 was not established in a special cell.

### BRIEF SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to develop a method and an equipment for implementing the method in such a way that said moving of a subscriber during a call can be taken into consideration in a way which is fair  
25 both to providers and users of communications services. The method and the equipment for implementing it should not require modifications to the mobile telephones. The objects of the invention are achieved by methods and systems which are characterized in what is set forth in the independent claims. The object of the dependent claims is constituted by preferred embodiments of  
30 the invention.

The invention is based on the use of intelligent network (IN) techniques. An example of such an intelligent networks is described in recommendations Q.1200 - Q.1219 of ITU-T. A service control point SCP of an intelligent network is provided with a charging criterion service, i.e. the determination of  
35 charging criteria is extended in such a way that a number of mobile network

cells is chosen as a group of special cells. If the location cell of a calling subscriber A (MS-A) or the called subscriber B (MS-B) belongs to such a group of special cells, a cheaper tariff is applied to the call. Also, the invention is based on monitoring during a call, for instance in connection with a handover,  
5 whether the new cell of the subscriber belongs to the group of special cells entitled to a more advantageous tariff.

An advantage of the method and the system according to the invention is that the price formation of a call is fair and real-time both for the mobile subscriber and the network operator. An implementation of the invention  
10 does not require any changes in existing hardware. Especially, implementing the invention requires no modification to the mobile telephones. Instead, all modifications can be concentrated within the fixed part of the network, e.g. by a change in the software of a service control point of a mobile switching centre and/or an intelligent network.

#### 15 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The invention will now be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 shows mobile network parts essential for the invention;

Figures 2 and 3 show alternative manners of transmitting cell information on a called subscriber to a charging criterion service attending to  
20 charging a calling subscriber.

#### DETAILED DESCRIPTION OF THE INVENTION

Indications as follows are used in the figures. Mobile Switching Centres MSC1 and MSC2 are centres serving a calling subscriber and a called  
25 subscriber, respectively, and comprising Service Switching Points SSP1 and SSP2 of an intelligent network. SCP1 and SCP2, respectively, are Service Control Points relating to MSC1 and MSC2. A Public Cell CP is a cell of a public switched telephone network and a Special Cell CS is a cell to which is applied a special tariff. The calling subscriber MS-A and the called subscriber  
30 MS-B are mobile subscribers. At least one of these subscribers can be a subscriber of a Private Branch eXchange PBX as well, in which case a default value cell is defined for at least part of the exchanges PBX and, additionally, a special charging criterion is applied in the method to calls during which the subscriber of the exchange network is within the area of the default value cell.

To illustrate the invention, but without restricting it in any way, a case is discussed in which a change in charging criterion is started by a change of location of the called subscriber. The network operator may, of course, set other criteria as well. It is thus for the operator to decide, whether a special tariff is applied when the calling subscriber, the called subscriber, one of the subscribers or both subscribers are located in a special cell CS.

Figure 1 shows a case to which is applied the charging criterion according to the invention. The starting point of a call can be e.g. a PNP call, which means that the calling subscriber and the called subscriber belong to the same enterprise or group of users which uses the same numbering plan (PNP, Private Numbering Plan). At the beginning of the call, the called subscriber is located in a public network cell CP. The location information on the called subscriber has been transmitted to the mobile switching centre MSC1 of the calling subscriber and it may have been used as a parameter for charging determination.

It is assumed that the called subscriber roams during the call from the public network area to a set of special cells CS (stage 1). At a handover, the cell information moves to the mobile switching centre MSC2 serving the called subscriber (stage 2). The mobile system (mobile switching centre MSC and/or service control point SCP) compares this cell information with the set of special cells CS and determines that the new cell of the called subscriber belongs to this set of special cells. Processing cell information may take place in different ways:

In one embodiment of the invention, information regarding the special cells CS relating to the called subscriber within the areas of different mobile switching centres are stored at the service control point SCP. In another embodiment of the invention, the centre MSC2 of the called subscriber and especially a related Visitor Location Register VLR obtain information on the special cells CS of the called subscriber from the service control point SCP2 at location updating. This function requires that the location updating can trigger an intelligent network service, in which the parameters of the called subscriber together with the information on the special cells are updated to correspond to the situation of this MSC/VLR.

Subsequently, the MSC2/SCP2 of the called subscriber can analyse a change in the called subscriber's cell information (stages 2' - 2'') and transmit information on that to the switching centre MSC1 of the calling sub-

scriber or to the service control point SCP1 (stage 3). This information may be e.g. a change in cell information from the public network cell CP to the set of special cells CS or the opposite. The MSC2/SCP2 of the called subscriber does not inform the MSC1 of the calling subscriber or the service control point SCP1 of the change in the cell information until the change is significant for the charging criteria. To avoid unnecessary signalling, it is preferable to estimate the permanence of the change, e.g. by using a short time hysteresis, before the change in the cell information is transmitted to the MSC1/SCP1 of the calling subscriber. A suitable length of time hysteresis is for instance approximately 10 seconds.

The mobile system sends the location information on the called subscriber to the MSC1/SCP1 of the calling subscriber, e.g. "cell information changed to the set of special cells". This information can be used in real time e.g. for the control of charging information visible on the phone.

Next, it will be described how the mobile communication system can transmit the location information on the called subscriber to the MSC/SCP of the calling subscriber. Alternative implementations are based on the functionality of the intelligent network and on combining that and e.g. the PLMN of the GSM system. The intelligent network can locally complement the functionality of the mobile switching centre MSC.

A change of cell information during a handover can be used for real-time updating of charging criteria in MSC/SCP. In cell-based charging, the price of a call is thus based on actual cell information. The mobile communication system monitors this cell information and compares it with the special cells defined to the subscriber in question. When MSC/SCP observes at a handover that the cell of the called subscriber has changed from a common cell CP into a special cell CS or vice versa, the system changes the charging criterion to correspond to the changed situation.

In connection with a handover, a Base Station Controller BSC gives the switching centre MSC a Handover\_Performed message. The message includes a Cell Identifier CI.

Still referring to Figure 1, cell information is transmitted according to the first alternative by utilizing inter-exchange signalling. The processing of the cell information takes place locally e.g. based on the functionality of the intelligent network. During a call, MSC2 receives, as a result of an internal handover of a base station (i.e. in a Handover\_Performed message), the iden-

tifier CI of the new cell of the called subscriber. A change related to that has been made in the switching centre MSC and, to be more exact, in its Basic Call State Model BCSM, due to which change a request for an intelligent network service can be made after the handover. When starting the service, the  
5 service control point SCP has set a triggering condition for the event (Event Detection Point EDP) "O\_handover".

After MSC2 has received the information on the handover (stage 2), it sends an information on that to SCP2 (stage 2'). Alternatively, MSC2 may have a triggering condition for starting this function, in which case MSC2 in-  
10 forms SCP2 of the cell and the subscriber. SCP2 answers MSC2 with cell type. During call establishment, SCP2 has examined whether the original cell of the called subscriber belongs to the group of special cells. According to the invention, SCP2 performs the same examination during the call, at the hand-  
over. It is assumed that this has taken place. In this case SCP2 informs MSC2  
15 that the cell type has changed from a public network cell into a special cell (stage 2"). MSC2 sends an information on the change of the cell type back-  
wards to MSC1 by using inter-exchange signalling (stage 3).

Additionally, it is preferable to restrict the inquiries to SCP concern-  
ing the called subscriber in such a way that an inquiry takes place only when  
20 the called subscriber is a subscriber, such as a PNP or VPN subscriber or the like, to which special cells are defined. Another alternative way is to utilize lo-  
cation updating. This will be described in the following.

As far as the load on the intelligent network is concerned, it is pref-  
erable to implement a solution as follows: when the mobile stations MS-A and  
25 MS-B perform location updatings in a location area where their special cells are located, information on special cells in a new location area to which a spe-  
cial tariff is applied is updated from SCP to VLR at the location updating. Con-  
sequently, the information on said subscriber having special cells within a lo-  
cation area is stored in VLR as per location. This technique is called "dynamic  
30 location updating". By this technique, unnecessary inquiries to the SCP of the  
intelligent network are avoided by the call control monitoring before triggering,  
as a triggering condition, whether special cells can be related to said call in  
said location area. An inquiry to SCP is made only if the triggering condition is  
fulfilled.

35 It shall be noted that an ISDN signalling ISUP according to the prior  
art (CCITT specifications Q.721 to Q.725) does not support transmitting cell

information backwards, due to which a non-standard, i.e. manufacturer-specific, definition of an ISUP charging message is required for the transmission of this information. Such a manufacturer-specific definition has been discussed in the same applicant's Finnish Patent Application 946091 and there especially in connection with the description relating to Figure 2 and in the Finnish Patent Application 946092 and there especially in connection with Figure 3.

Cell information may consist of a mere changed cell or it may include a result, analysed by SCP2, of whether the called subscriber's new cell belongs to the group of special cells. When MSC1 receives this information, it may ask SCP1 to analyse the cell information, if SCP2 has not made it already.

According to a second alternative described in Figure 2, the cell information is transmitted much in the same way as according to the first alternative described in connection with Figure 2. In this alternative, MSC2/SSP2 sends the cell information by utilizing INAP protocol directly to SCP1 (stage 3). MSC2/SSP2 acts as a so-called Assisting/Hand-Off SSP. The INAP protocol has been described in the document prETS300 374-1,1 Intelligent Network (IN): Intelligent Network Capability Set 1 (CS1), Core Intelligent Network Application Protocol (INAP), Part 1, Protocol Specification. MSC2 has received the address of SCP1 and an identifier of a program responsible for the service in an Initial Address Message IAM, for instance. As to the rest, the second alternative agrees with the first one.

According to a third alternative described in Figure 3, there is a direct signalling connection between SCP1 and SCP2. The INAP protocol does not support this at the moment. Alternatively, also Mobile Application Part (MAP) signalling can be used, in which is made a change to support the transmission of the cell information. In this alternative, SCP2 informs SCP1 directly of the called subscriber's location. After having received a response message, MSC1 sends a request for charging information to SCP1 (stage 3).

In the Figures 1 to 3, it is assumed that the service control points SCP1 and SCP2 comprise data bases SDP1 and SDP2, respectively, which are not shown separately in the figures. Alternatively, the service control points SCP1 and SCP2 can be connected to one common data base. The same service control point SCP1 or SCP2 may naturally serve also two or more mo-

mobile switching centres MSC1- MSC2. For the invention, the architecture of the intelligent network is not essential.

The invention has been described by way of example in connection with a GSM system or its derivatives. On the basis of the above description, it is easy for one skilled in the art to apply the invention also to other mobile systems. Accordingly, the invention and its embodiments are not restricted to the above examples, but they can be modified within the scope of the claims.

## CLAIMS

1. A method of improving charging criteria for a call in a cellular mobile network, in which a mobile switching centre (MSC1, MSC2) comprises a service switching point (SSP1, SSP2) of an intelligent network, providing a user with an access to services of a service control point (SCP1, SCP2),  
said method being **characterized** in that  
at least some cells of the mobile network constitute a set of special cells comprising at least one cell (CS);  
the service control point (SCP1, SCP2) is provided with a charging criterion service applying a special charging criterion defined for the set of special cells, to calls during which the cell of at least one subscriber (MS-A, MS-B) belongs to the set of special cells (CS); and  
during the call, it is also being monitored whether the cell of at least one subscriber (MS-A, MS-B) belongs to the set of special cells (CS) entitled to a more advantageous tariff.
2. A method according to claim 1, **characterized** in that it is examined in connection with a handover whether the cell of at least one subscriber (MS-A, MS-B) is included in the set of special cells (CS).
3. A method according to claim 1 or 2, **characterized** in that the special cells (CS) relating to the subscribers (MS-A, MS-B) within the areas of the different mobile switching centres (MSC1, MSC2) are stored at the service control point (SCP1, SCP2) of the intelligent network.
4. A method according to any of the claims 1 to 3, **characterized** in that the mobile switching centre (MSC1, MSC2) serving at least one subscriber (MS-A, MS-B) and/or a related visitor location register (VLR1, VLR2) receives at location updating an information on that at least one subscriber (MS-A, MS-B) has special cells within said location area.
5. A method according to claim 4, **characterized** in that the mobile switching centre (MSC1, MSC2) serving at least one subscriber (MS-A, MS-B) and/or the related visitor location register (VLR1, VLR2) receives at location updating an information on said subscriber's special cells (CS) from the service control point (SCP1, SCP2) of the intelligent network.
6. A method according to any of the claims 1 to 5, **characterized** in that the information on the called subscriber's location cell is transmitted from the mobile switching centre (MSC2) serving the called subscriber to the mobile switching centre (MSC1) serving the calling subscriber.

7. A method according to any of the claims 1 to 5, **characterized** in that the information on the called subscriber's location cell is transmitted from the intelligent network service switching point (SSP2) serving the called subscriber to the service control point (SCP1) serving the calling subscriber.

8. A method according to any of the claims 1 to 5, **characterized** in that the information on the subscriber's location cell is transmitted from the intelligent network service control point (SCP2) serving the called subscriber to the service control point (SCP1) serving the calling subscriber.

9. A method according to any of the preceding claims, **characterized** in that the service control point (SCP1, SCP2) of the intelligent network is asked for information on the called subscriber's location cell only if the called subscriber is a subscriber to which are allocated special cells (CS).

10. A method according to any of the preceding claims, **characterized** in that a default value cell is determined for at least part of the exchanges (PBX) and, additionally, special charging criteria are applied in the method to calls during which the subscriber of the exchange network is located within the area of the default value cell.

11. A method according to any of the preceding claims, **characterized** in that, before changing the charging criteria, it is monitored by means of time hysteresis that the change in cell information is permanent.

12. A method according to any of the preceding claims, **characterized** in that when the charging criteria change, an information on the change is transmitted to the calling subscriber's mobile station.

13. A mobile system comprising at least two cells, at least one of the cells constituting a set of special cells (CS); a mobile switching centre (MSC1, MSC2) and a related service switching point (SSP1, SSP2) of an intelligent network and also a service control point (SCP1, SCP2) of the intelligent network; **characterized** in that

the service control point (SCP1, SCP2) is provided with a charging criterion service applying a special tariff, defined for the set of special cells (CS), to calls at the beginning of which at least one of the subscribers (MS-A, MS-B) is located in a cell (CS) belonging to the set of special cells; and

the charging criterion service further comprises a function for monitoring during a call whether the cell of at least one subscriber (MS-A, MS-B) belongs to the set of special cells (CS) entitled to said special tariff.

Fig. 1

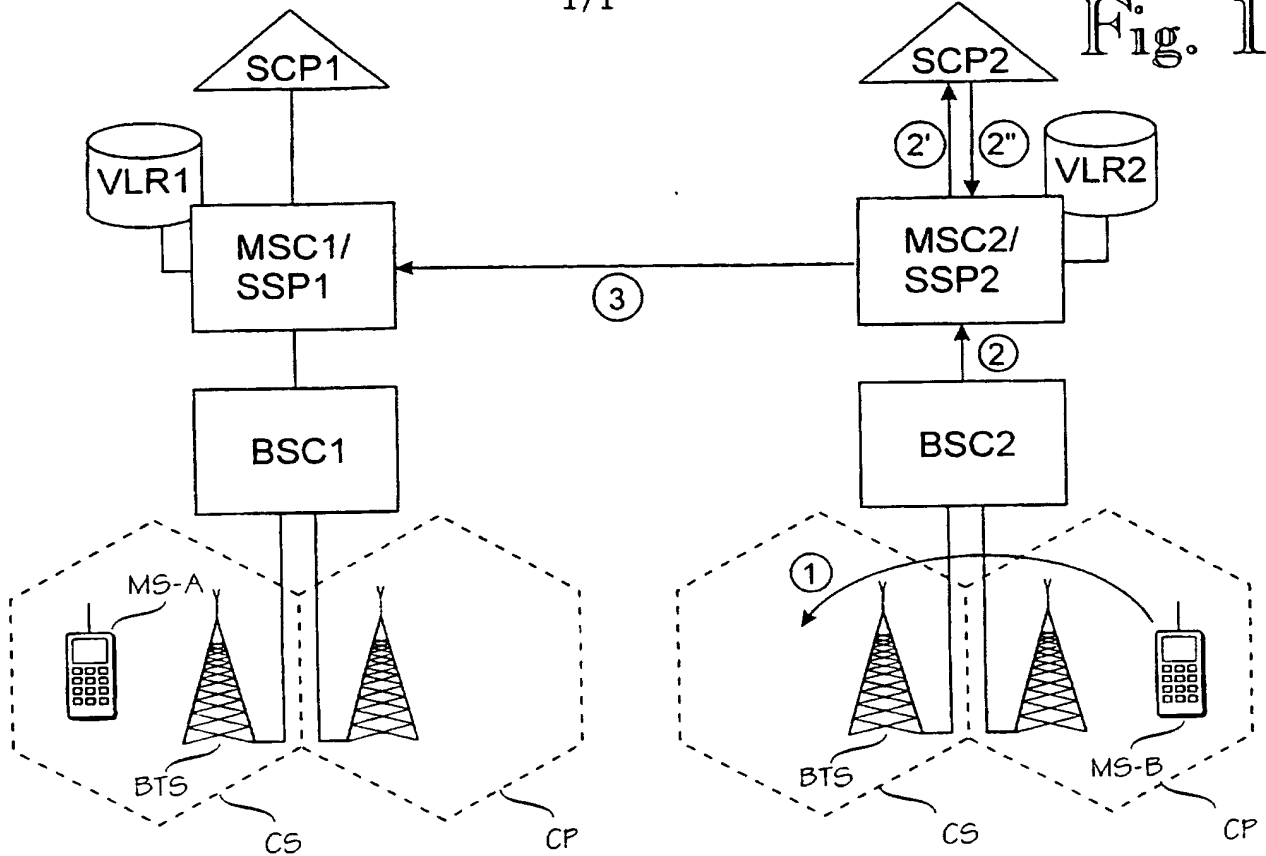


Fig. 2

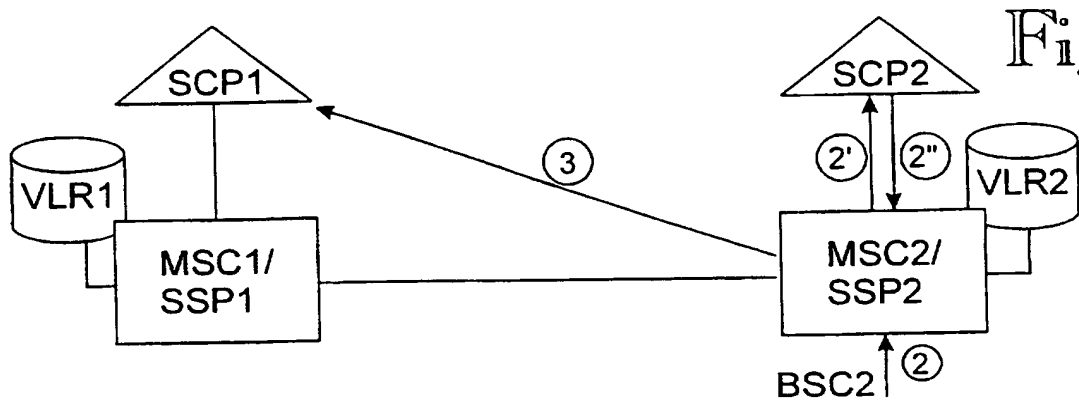
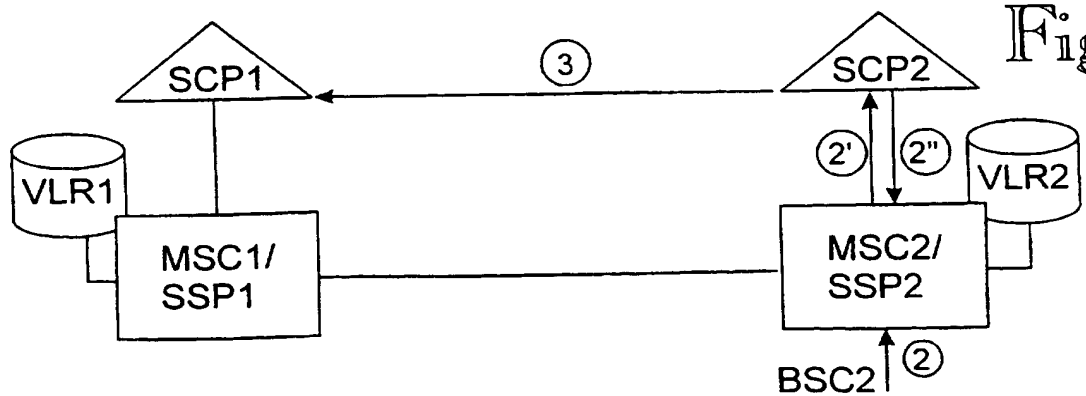


Fig. 3



## INTERNATIONAL SEARCH REPORT

ational application No.  
PCT/FI 97/00346

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0597638 A1 (VODAFONE LIMITED), 18 May 1994 (18.05.94), column 2, line 17 - column 3, line 53 --	1-3,12,13
X	US 5295180 A (VENDETTI ET AL), 15 March 1994 (15.03.94), column 4, line 30 - column 5, line 60 --	1,3,12,13
P,X	WO 9620570 A1 (NOKIA TELECOMMUNICATIONS OY), 4 July 1996 (04.07.96), page 6, line 25 - page 9, line 29 --	1,3-8,12,13
A	US 5260987 A (MAUGER), 9 November 1993 (09.11.93), see the whole document. -- -----	1-13

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

27 October 1997

Date of mailing of the international search report

30 -10- 1997

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Bo Gustavsson

Telephone No. +46 8 782 25 00

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

01/10/97

International application No.

PCT/FI 97/00346

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
EP	0597638	A1	18/05/94	AU	5056893 A	26/05/94
				GB	2272607 A	18/05/94
US	5295180	A	15/03/94	CA	2083791 A	09/10/93
				EP	0568824 A	10/11/93
				JP	6105364 A	15/04/94
				US	5600706 A	04/02/97
WO	9620570	A1	04/07/96	AU	4262396 A	19/07/96
				FI	97510 B,C	13/09/96
				FI	946091 A	24/06/96
				NO	972889 A	20/06/97
US	5260987	A	09/11/93	AT	147920 T	15/02/97
				CA	2044435 A	19/12/91
				DE	69124144 D,T	30/04/97
				EP	0462728 A,B	27/12/91
				SE	0462728 T3	
				GB	2245455 A,B	02/01/92
				NO	179388 B,C	17/06/96